Mini-Track Introduction for Electric Power Monitoring and Control Systems

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This minitrack is on topics related to the monitoring, control, and protection of electric power systems for real-time operations and short-term operations planning. This year the emphasis has been on recent developments in the area of large-scale dynamic research for power systems and on hybrid and distributed control concepts for decentralized command and control of existing critical energy infrastructures.

The first session focuses on issues associated with large-scale power system dynamics and control. The power system is a large-scale nonlinear system consisting of hundreds of dynamic components including synchronous generators and their controls, nonlinear loads, and complex power electronic devices such as in wind generators and in flexible transmission controllers. Modeling and simulation of the underlying large-scale differential-algebraic equations are essential for understanding fundamental questions in power system planning and operations. Recent measurement based real-time monitoring and control algorithms are providing a renewed look at the dynamic phenomena of interconnected power system through synchronized wide-area measurements in the form of Phasor Measurement Units (PMUs). With the availability of such large-scale synchronized measurements available in the power system today, there is an urgent need to combine model-based power system dynamic research and measurement-based monitoring and control algorithms towards advancing real-time operational reliability of electric power grids. Increased reactive power demands during unplanned for events such as from geomagnetic disturbances (GMDs) can push the system towards voltage collapse scenarios. This session will showcase recent developments in the area of large-scale dynamic research in the power system area.

This year's papers address the following topics: synchronous machine parameter calibration, extraction of frequency events from extremely large datasets, improving ability of mode meters to detect forced oscillations, use of probing signals for power system identification, use of synchrophasor-based technologies to improve security analysis, and approaches for assessing the small signal-stability of power systems.

The second session addresses distributed control concepts that can be integrated into a more decentralized command and control of existing critical energy infrastructures. The world's developed economies will increasingly be required to manage heterogeneous and dispersed infrastructure-scale systems of systems such as our critical energy, power, computing and transportation systems. There is an emerging recognition of the need for new control techniques that will allow us to develop, test and integrate distributed resources with growing dispersed intelligence and diverging objectives. Papers in this session present new control theory, tools and testbeds that support the development of a sound scientific basis for controlling large-scale energy infrastructure using diverse resources including distributed generation and loads. They address the fundamental obstacles to generalizable methodologies for controlling large-scale complex engineered systems while economically and reliably achieving evolving local and global performance objectives.

This year's papers address the following topics: control schemes for managing operational stability of microgrids, fault detection, location and classification for distribution systems with high PV penetration, and unified models for representing networks of inverter-based resources.

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